Visit

FREETESTPAPER.com

for more papers

Website: freetestpaper.com

Facebook.com/freetestpaper

Twitter.com/freetestpaper

CANBERRA SECONDARY SCHOOL

2020 Preliminary Examination

Secondary Four Express / Five Normal Academic

SCIENCE (PHYSICS/CHEMISTRY)
5076/01

31 Aug 2020
1 hour
0830h – 0930h

Name: _____ ( ) **Class:** _____

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your full name, class and index number in the spaces provided on the question paper and on any separate writing papers used.
Write in soft pencil.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Read the instructions on the Answer Sheet (OTAS) very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is printed on page 19.

FOR MARKER'S USE		
	Marks Awarded	Max Marks
Section A		38
Total		38

This question paper consists of 19 printed pages including the cover page.

Setter: Mrs Olivia Ho & Mrs Zoanne Tay

There are **forty** questions on this paper. For each question there are four possible answers **A, B, C** and **D**

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet (OTAS).

Questions set on the Common Last Topic of the syllabus do not form part of the assessment. They will not be marked by the Examiners.

Do **not** answer the following questions:

Question 39 on page 17

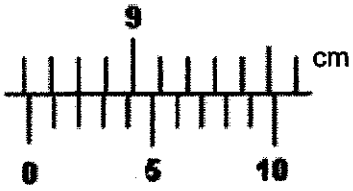
Question 40 on page 17

Turn to these questions and cross them out by drawing a line through these questions.

The total time allowed for this Question Paper has **not** been changed.

The total mark for this Question paper is now **38**.

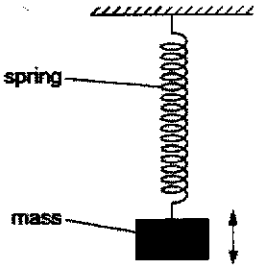
1 The diagram shows a Vernier caliper after it has been used to measure the diameter of a pipe.



Given that the Vernier caliper has a zero error of -0.02 cm, what is the diameter of the pipe?

A	8.60 cm	**B**	8.62 cm
C	8.64 cm	**D**	8.72 cm

2 The diagram below shows a mass suspended on a spring. The mass is displaced downwards and released. It takes the mass 0.2 s to move from the lowest to the highest position.



What is the frequency of oscillation?

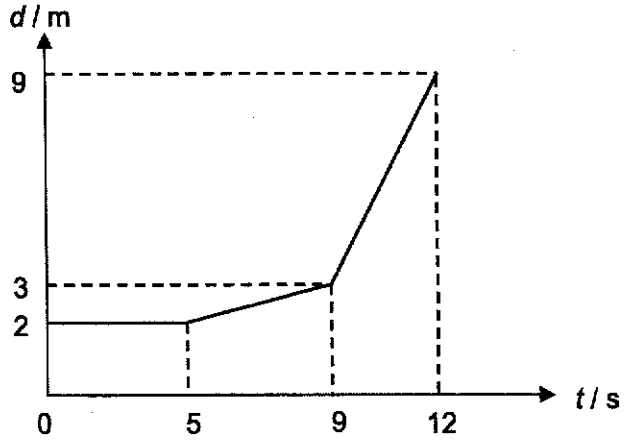
A	0.20 Hz	**B**	1.25 Hz
C	2.50 Hz	**D**	5.00 Hz

3 A 100 g marble is falling through air as shown below. Assume that air resistance is negligible.

Which of the following is the likely resultant force acting on the marble?

A	0 N	**B**	0.7 N
C	1 N	**D**	1.7 N

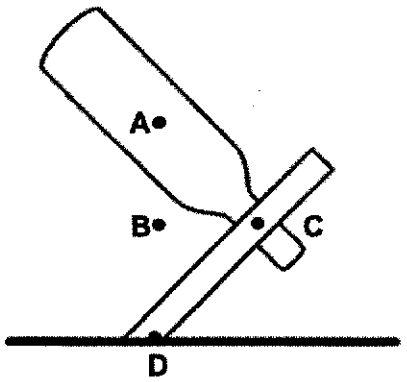
4 The distance-time graph of a toy cart is shown below.



What was the average speed for the entire motion?

A	0.50 m/s	**B**	0.58 m/s
C	0.75 m/s	**D**	1.00 m/s

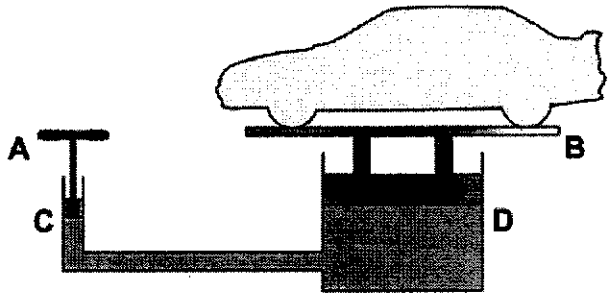
5 The diagram below shows a setup of a novelty wine bottle holder with a bottle of wine. At which of the points shown is likely the centre of gravity of the setup?



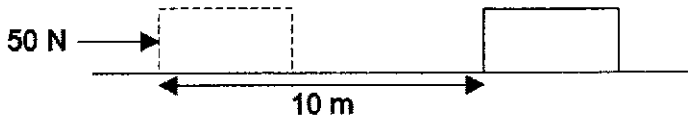
6 A cylindrical container has a base area of **A** and height of **h**. When empty, it has a mass of **m**. When it is fully filled with an unknown liquid, it has a mass of **M**. What is the density of the unknown liquid?

A	$\frac{M-m}{A \times h}$	**B**	$\frac{M}{A \times h}$
C	$(M-m)(A \times h)$	**D**	$\frac{A \times h}{M}$

7 A hydraulic jack is used to raise a car as shown in the diagram below. Which one of the following areas must be reduced to enable heavier loads to be lifted if the force applied at the handle remains unchanged?



8 A box is pushed along a smooth surface with a 50 N force over a distance of 10 m in 4 s.



What is the power exerted on the box over this period of time?

A	5 W	**B**	125 W
C	500 W	**D**	2000 W

9 Which of the following is true when a sample of pure liquid is freezing?

	Internal KE	**Internal PE**
A	decrease	increase
B	increase	remain the same
C	decrease	remain the same
D	remain the same	decrease

10 A space shuttle is normally painted white to ensure the cockpit is **not** overheated by the Sun. This is because

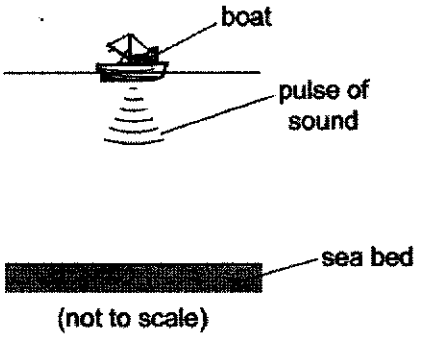
A white color materials are good absorber of radiation.

B white color materials are poor absorber of radiation.

C white color materials are poor emitter of radiation.

D white color materials are good conductor of radiation.

11 Sonar can be used in mapping of underwater terrain. A pulse of sound is emitted and the time taken for the echo to be recorded is 1.5 s.



What is the depth of the seabed given the speed of sound in sea water is 1500 m/s?

A 562 m **B** 1125 m

C 1688 m **D** 2250 m

12 Which of the following electromagnetic wave is the ionizing radiation with the longest wavelength?

A X-ray

B microwave

C gamma ray

D infrared radiation

13 A radio antenna is designed to receive signals with wavelength between 10 mm to 100 mm. What is the frequency range of the signal for this antenna?

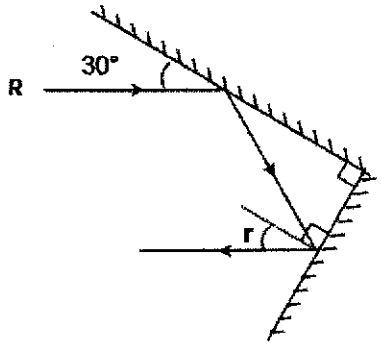
A 3×10^{6} Hz to 3×10^{7} Hz

B 3×10^{9} Hz to 3×10^{10} Hz

C 3×10^{10} Hz to 3×10^{11} Hz

D 3×10^{13} Hz to 3×10^{14} Hz

14 The figure shows the path of a light ray **R** being reflected by two mirrors placed perpendicularly to each other.



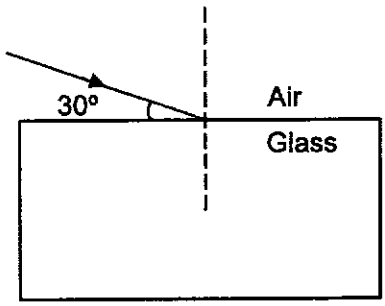
What is the value of **r**?

A	20°	**B**	30°
C	45°	**D**	60°

15 The speed of light in a clear plastic is 1.2×10^8 m/s. What is the refractive index of the plastic?

A	0.40	**B**	1.20
C	1.80	**D**	2.50

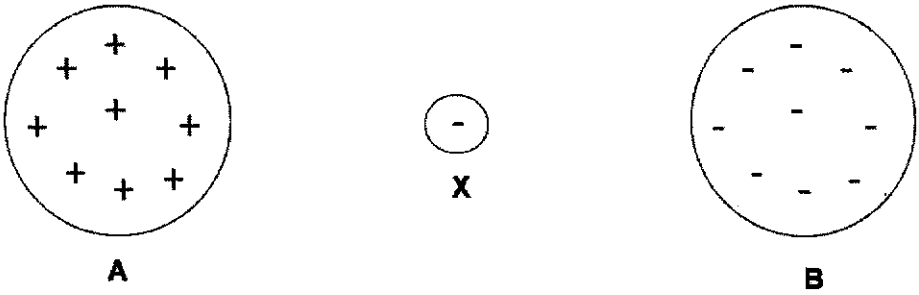
16 A red light was shone into the glass block as shown in the diagram below. It strikes the glass block with an angle of 30° to the air-glass boundary.



Given that the glass block has a refractive index of 1.35, what is the angle of refraction as the red light enters into the glass block?

A	39.9°	**B**	21.7°
C	42.5°	**D**	10.5°

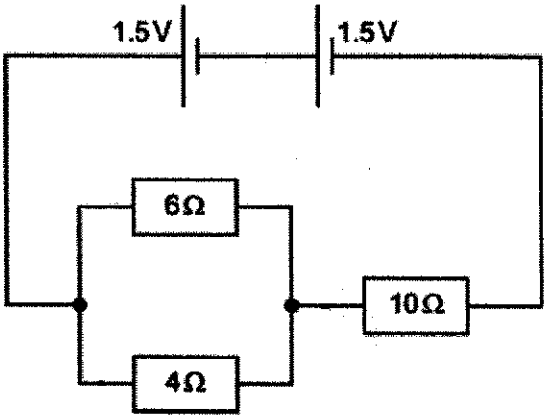
17 A positive charge **A** and a negative charge **B** are placed a short distance apart and a small negative charge **X** is placed between them.



In which direction does **X** move, and what is the force between **A** and **B**?

	movement of **X**	force between **A** and **B**
A	towards **A**	attraction
B	towards **B**	attraction
C	towards **A**	repulsion
D	towards **B**	repulsion

18 The diagram shows a circuit.

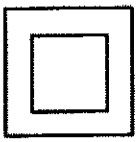


What is the amount of current flowing through the 10Ω resistor?

A 0.10 A **B** 0.15 A

C 0.24 A **D** 0.30 A

19 An electrical appliance has the following symbol on it.



Which of the following electrical safety device is **not** necessary?

A fuse

B circuit breaker

C earth wire

D switch

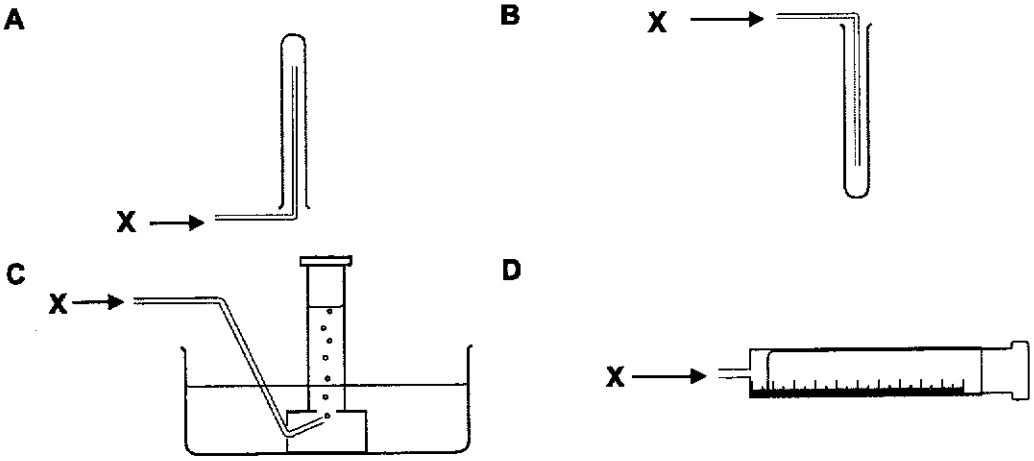
20 How many "100 W, 240 V" lamps can be connected in parallel to a socket fitted with a 13 A fuse?

A	5	**B**	6
C	31	**D**	32

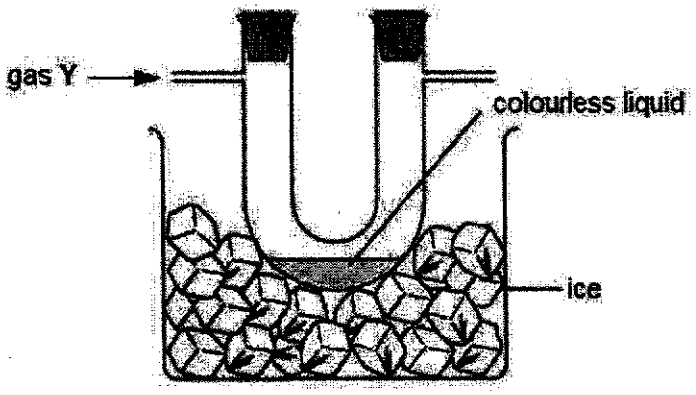
21 Gas **X** has the following properties:

- less dense than air
- insoluble in water

Which method **cannot** be used to collect the gas **X**?



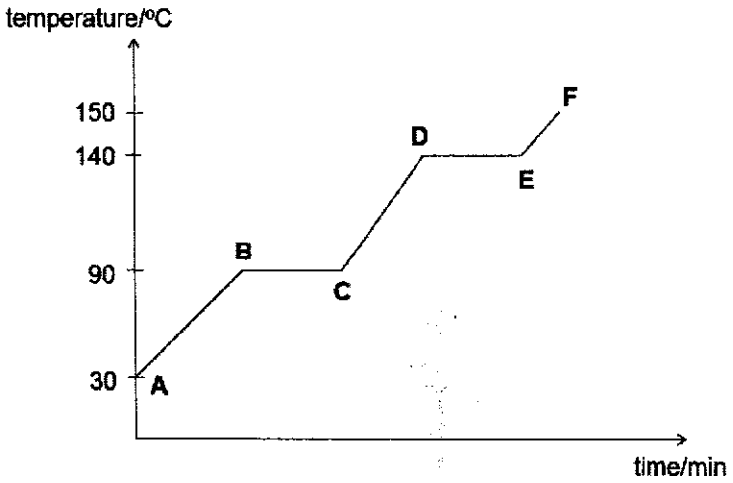
22 A gas, **Y**, was collected by passing through a U-tube immersed in an ice mixture. The gas condensed into a colourless liquid.



What could be the melting and boiling points of **Y**?

	melting point/°C	boiling point/°C
A	180	204
B	-81	-84
C	-114	152
D	-123	21

23 The graph below shows the temperature changes during the heating of solid **X** at atmospheric pressure.



Which of the following changes shows the greatest increase in volume of solid **X**?

A **DE → EF** **B** **CD → EF**

C **BC → CD** **D** **AB → EF**

24 A substance has the chemical formula of $HOCH_2CH(NH_2)COOH$. Which of the following statements about the substance is correct?

A It contains 4 different elements.

B It does not have a fixed composition by mass.

C It can be separated into its constituents by fractional distillation.

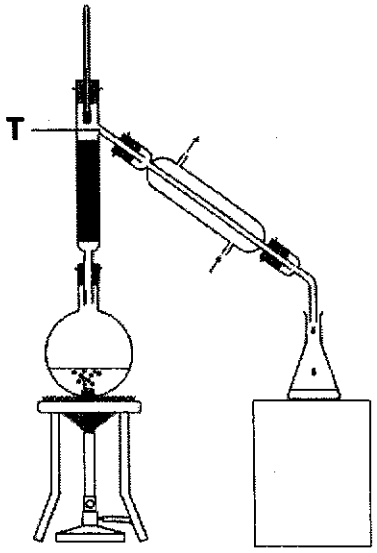
D Its chemical properties are the same as those of its components.

25 Impure solid **Y** melts around 131 °C. What could be the melting point of pure **Y**?

A 135 °C **B** 131 °C

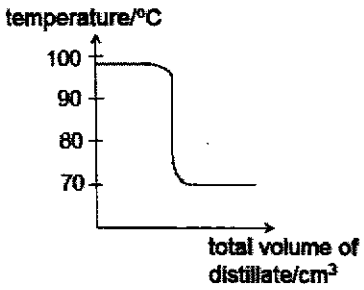
C 129 °C **D** 126 °C

26 The diagram shows apparatus used to separate hexane (boiling point, 70 °C) and heptane (boiling point, 98 °C).

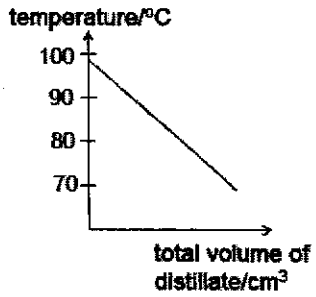


Which graph would be obtained if the temperature at point **T** was plotted against the total volume of distillate collected?

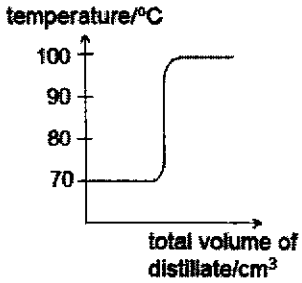
A



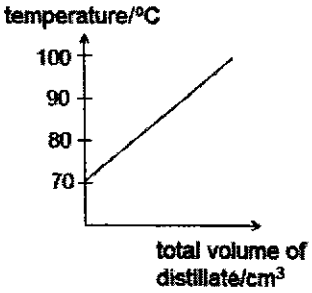
B



C



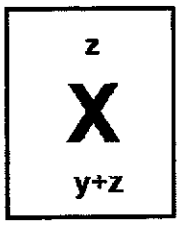
D



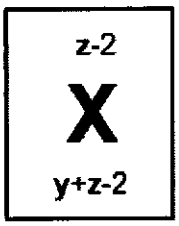
27 An ion X^{2-} contains **y** neutrons and **z** electrons.

Which of the following represents the chemical symbol of **X** shown in the Periodic Table?

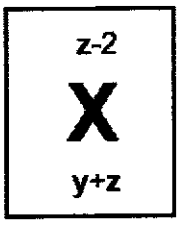
A



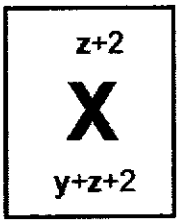
B



C



D



28 Element **M** has electronic configuration of 2,8,7.
Element **N** has electronic configuration of 2,6.

Which statement best describes the compound formed between element **M** and element **N**?

A The particles in the compound are held by strong electrostatic forces of attraction.
B The compound is able to conduct electricity at room temperature and pressure.
C The compound has a chemical formula of $\mathbf{MN_2}$.
D The compound is soluble in organic solvent.

29 What is the percentage by mass of water in copper(II) nitrate crystals, $Cu(NO_3)_2.3H_2O$?

A 22.3 %
B 10.5 %
C 10.0 %
D 7.43 %

30 The table shows information about three indicators.

indicator	colour at pH 1	pH at which colour changes	colour at pH 12
Congo red	blue	5	red
Thymol blue	red	3	yellow
Phenolphthalein	colourless	10	pink

All three indicators were added together to a sample of pure distilled water.

Which colour would be observed?

A violet **B** red
C orange **D** green

31 Which of the following elements burns in excess oxygen to form a neutral oxide?

A zinc **B** sulfur
C hydrogen **D** carbon

32 Which pair of reagents is best used to prepare potassium nitrate crystals?

A aqueous potassium carbonate and dilute nitric acid
B aqueous potassium chloride and aqueous calcium nitrate
C aqueous potassium sulfate and dilute nitric acid
D potassium metal and dilute nitric acid

33 In the Periodic Table, francium is in the same group as lithium and potassium.

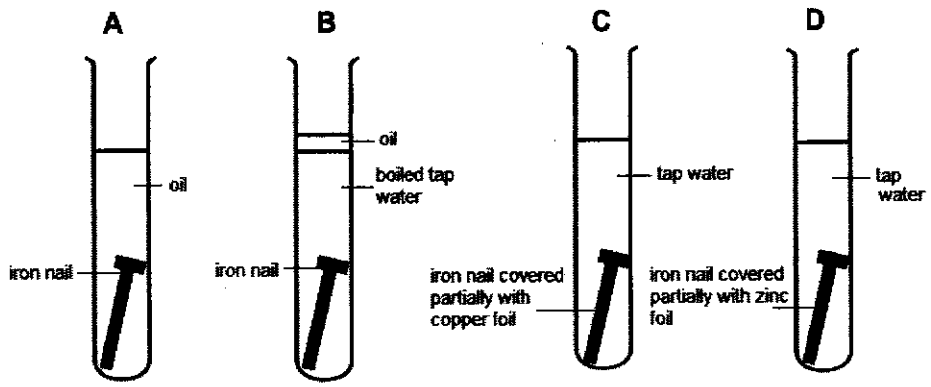
Which statement about francium is likely to be correct?

A It forms a nitrate with the formula of $Fr(NO_3)_2$.
B It has a melting point lower than potassium.
C It forms an insoluble hydroxide.
D It reacts slowly with cold water.

34 The following set-up is used to investigate the rate of rusting of iron nails under different conditions.

Test tubes **A** and **B** contain iron nails that are covered partially with copper foil and zinc foil respectively.

In which test tube will rusting of iron take place the fastest?



35 Which of the following involves an endothermic change?

A $H_2O\ (l) \rightarrow H_2O\ (s)$

B $NH_4Cl\ (s) \rightarrow NH_4Cl\ (aq)$

C $CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g)$

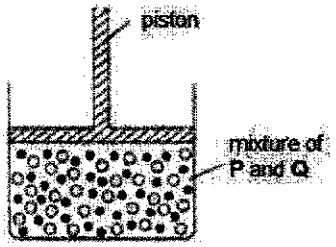
D $C_6H_{12}O_6\ (s) + 6O_2\ (g) \rightarrow 6CO_2\ (g) + 6H_2O\ (l)$

36 Which row best describes what happens when a substance undergoes reduction?

	oxygen	electron
A	loss	gain
B	loss	loss
C	gain	gain
D	gain	loss

37 Two gases **P** and **Q** react to produce gas **R**.

Both **P** and **Q** are placed in a container at room temperature as shown in the diagram below.



Which of the following ways would increase the speed of reaction?

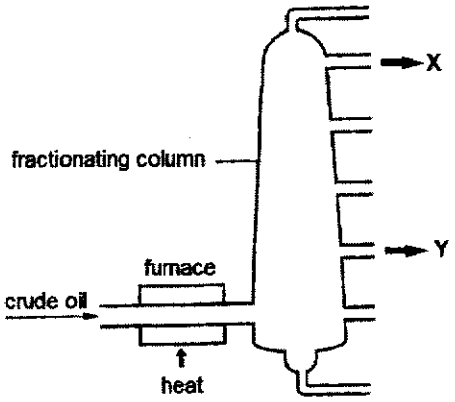
A Push the piston downwards.
B Add argon into the container.
C Decrease the amount of **P** particles in the container.
D Decrease the temperature of the mixture in the container.

38 A sample of polluted air contains carbon dioxide, carbon monoxide, nitrogen, sulfur dioxide and water vapour.

Which gases can also be found in a dry sample of unpolluted air?

A carbon dioxide, carbon monoxide and nitrogen only
B carbon monoxide, nitrogen and sulfur dioxide only
C carbon dioxide, nitrogen and water vapour only
D carbon dioxide and nitrogen only

39 The diagram below represents the process of fractional distillation of crude oil.



Which of the following statements about fractions **X** and **Y** is correct?

A **Y** burns more easily than **X**.

B **Y** consists of smaller molecules than **X**.

C **Y** has a lower boiling point than **X**.

D **Y** is more viscous than **X**.

40 Useful fractions are obtained by fractional distillation of petroleum.

Which fraction correctly matches its use?

	fraction	use
A	diesel	fuel for buses and lorries
B	kerosene	fuel for motorcars
C	naphtha	fuel for aircraft engines
D	petrol	fuel for cooking and heating

- END OF PAPER –

DATA SHEET

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of the Elements

key

proton (atomic) number
atomic symbol
name
relative atomic mass

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 **H** hydrogen 1										2 **He** helium 4
3 **Li** lithium 7	4 **Be** beryllium 9											5 **B** boron 11	6 **C** carbon 12	7 **N** nitrogen 14	8 **O** oxygen 16	9 **F** fluorine 19	10 **Ne** neon 20
11 **Na** sodium 23	12 **Mg** magnesium 24											13 **Al** aluminium 27	14 **Si** silicon 28	15 **P** phosphorus 31	16 **S** sulfur 32	17 **Cl** chlorine 35.5	18 **Ar** argon 40
19 **K** potassium 39	20 **Ca** calcium 40	21 **Sc** scandium 45	22 **Ti** titanium 48	23 **V** vanadium 51	24 **Cr** chromium 52	25 **Mn** manganese 55	26 **Fe** iron 56	27 **Co** cobalt 59	28 **Ni** nickel 59	29 **Cu** copper 64	30 **Zn** zinc 65	31 **Ga** gallium 70	32 **Ge** germanium 73	33 **As** arsenic 75	34 **Se** selenium 79	35 **Br** bromine 80	36 **Kr** krypton 84
37 **Rb** rubidium 85	38 **Sr** strontium 88	39 **Y** yitrium 89	40 **Zr** zirconium 91	41 **Nb** niobium 93	42 **Mo** molybdenum 96	43 **Tc** technetium -	44 **Ru** ruthenium 101	45 **Rh** rhodium 103	46 **Pd** palladium 106	47 **Ag** silver 108	48 **Cd** cadmium 112	49 **In** indium 115	50 **Sn** tin 119	51 **Sb** antimony 122	52 **Te** tellurium 128	53 **I** iodine 127	54 **Xe** xenon 131
55 **Cs** caesium 133	56 **Ba** barium 137	57 – 71 lanthanoids	72 **Hf** hafnium 178	73 **Ta** tantalum 181	74 **W** tungsten 184	75 **Re** rhenium 186	76 **Os** osmium 190	77 **Ir** iridium 192	78 **Pt** platinum 195	79 **Au** gold 197	80 **Hg** mercury 201	81 **Tl** thallium 204	82 **Pb** lead 207	83 **Bi** bismuth 209	84 **Po** polonium -	85 **At** astatine -	86 **Rn** radon -
87 **Fr** francium -	88 **Ra** radium -	89 - 103 actinoids	104 **Rf** Rutherfordium -	105 **Db** dubnium -	106 **Sg** seaborgium -	107 **Bh** bohrium -	108 **Hs** hassium -	109 **Mt** meitnerium -	110 **Ds** darmstadtium -	111 **Rg** roentgenium -	112 **Cn** copernicium -		114 **Fl** flerovium -		116 **Lv** livermorium -		

lanthanoids	57 **La** lanthanum 139	58 **Ce** cerium 140	59 **Pr** praseodymium 141	60 **Nd** neodymium 144	61 **Pm** promethium -	62 **Sm** samarium 150	63 **Eu** europium 152	64 **Gd** gadolinium 157	65 **Tb** terbium 159	66 **Dy** dysprosium 163	67 **Ho** holmium 165	68 **Er** erbium 167	69 **Tm** thulium 169	70 **Yb** ytterbium 173	71 **Lu** lutetium 175
actinoids	89 **Ac** actinium -	90 **Th** thorium 232	91 **Pa** protactinium 231	92 **U** uranium 238	93 **Np** neptunium -	94 **Pu** plutonium -	95 **Am** americium -	96 **Cm** curium -	97 **Bk** berkelium -	98 **Cf** californium -	99 **Es** einsteinium -	100 **Fm** fermium -	101 **Md** mendelevium -	102 **No** nobelium -	103 **Lr** lawrencium -

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

CANBERRA SECONDARY SCHOOL

2020 Preliminary Examination

Secondary Four Express / Five Normal Academic

SCIENCE (CHEMISTRY)
5076/03
5078/03

12 Aug 2020
1 hour 15 minutes
1110h – 1225h

Name: _____ ( ) **Class:** _____

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your full name, class and index number in the spaces provided on the question paper.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

You may use a calculator for this examination.

A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.

For Marker's Use		
Section	Marks Awarded	Max Marks
A		45
B		20
Total		65

This question paper consists of 16 printed pages including the cover page.

Setter: Mrs Zoanne Tay

This paper consists of **Section A** and **Section B**.

Answer **ALL** the questions in Section A and **TWO** questions in Section B.

The number of marks is given in brackets [ ] at the end of the question or part question.

Questions set on the Common Last Topic of the syllabus do not form part of the assessment. They will not be marked by the Examiners.

Do not answer the following questions:
Question B11 on page 13 and 14

Turn to these questions and cross them out by drawing a line through these questions.

In Section B you must answer Question B9 and B10. There is now no choice of question in this Section.

The total time allowed for this Question Paper has **not** been changed.

Section A: [45 marks]

Answer **all** the questions. Write your answers in the spaces provided.

A1 The diagram below shows part of the Periodic Table.

				H						
Li	Be					B	C	N	O	F
Na	Mg					Al	Si	P	S	Cl
K	Ca			Cu	Zn	Ga	Ge	As	Se	Br
Rb	Sr									I

Answer the following questions using only the symbol of the elements shown in the diagram.

Each element can be used once, more than once or not at all.

(a) Which two elements form the gas that is produced from power stations and causes acid rain?

..... [1]

(b) Which element is found in an acid that produces white precipitate when acidified aqueous silver nitrate is added?

..... [1]

(c) Which element exists as a pale yellow gas at room temperature and pressure?

..... [1]

(d) Which two elements form a compound, which is used to test for the presence of an oxidising agent?

..... [1]

A2 The table below contains details of six different particles. The letters are **not** the chemical symbols.

	K	L	M	N	O	P
nucleon number	35	32	23	1	37	7
proton number	17	16	11	1	17	3
number of electrons	18	16	11	1	20	2

Use the table above to state which of the particles, **K**, **L**, **M**, **N**, **O** and **P**.

(a) has no subatomic particles with relative charge of 0, ...

(b) is placed in Group VI of the Periodic Table, ...

(c) are both isotopes of the same element, ...

(d) is an atom that will form an ionic compound with **L**, ...

(e) is an ion with a single positive charge. ..... [5]

A3 10.0 g of sodium thiosulfate, $Na_2S_2O_3$ was reacted with 200 cm^3 of 0.20 mol/dm^3 of dilute hydrochloric acid. The chemical equation for the reaction is as shown below.

$$Na_2S_2O_3\ (s) + 2HCl\ (aq) \rightarrow 2NaCl\ (aq) + S\ (s) + SO_2\ (g) + H_2O\ (l)$$

(a) Identify the limiting reagent in this reaction.

[3]

(b) Hence, calculate the volume of sulfur dioxide produced.

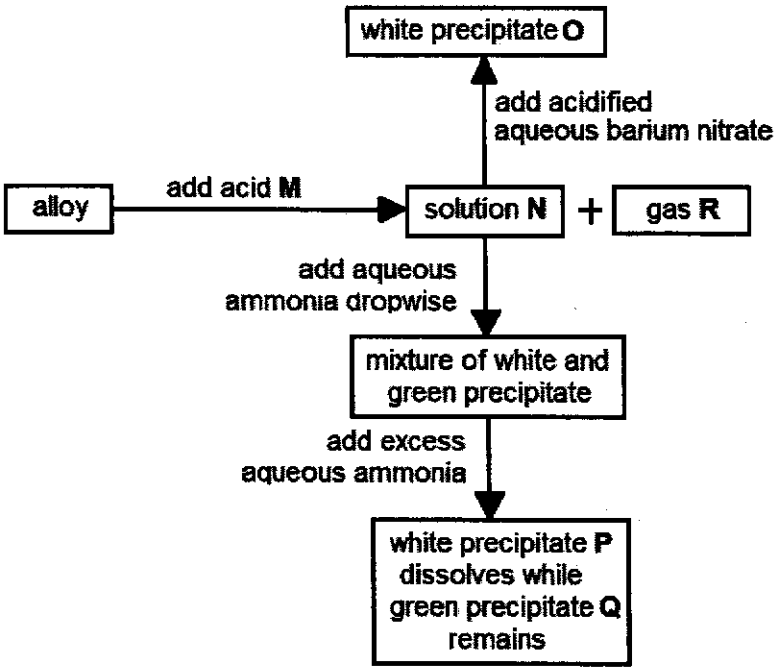
[1]

(c) Explain why this reaction has to be carried out in a well-ventilated space.

.....

..... [1]

A4 The diagram below shows a series of tests conducted using a sample of an alloy containing two metals.



(a) Identify the following substances:

M: .....

O: .....

R: ..... [3]

(b) Identify the two metals present in the alloy.

..... [2]

(c) Write an ionic equation for the formation of white precipitate **O**.

..... [1]

A5 Four metals, **W**, **X**, **Y** and **Z** are tested with cold water, steam and dilute hydrochloric acid separately.

The table below shows the results of the experiment.

metal	reaction with			
	cold water	steam	dilute hydrochloric acid	aqueous copper(II) sulfate
W	x	√	√	
X	√	√	√	
Y	x	x	x	
Z	x	x	√	

key:
√: reaction occurred
x: no visible reaction

(a) Arrange the four metals, **W**, **X**, **Y** and **Z** in increasing order of reactivity.

..... [1]

(b) Predict the reaction of the four metals with aqueous copper(II) sulfate by filling in the blanks with '√' or 'x' in the table above. [2]

(c) Metal **W** is often mixed with carbon to form an alloy, steel, in industries.

(i) Identify metal **W**.

..... [1]

(ii) Explain why steel is preferably used in industries as compared to metal **W**.

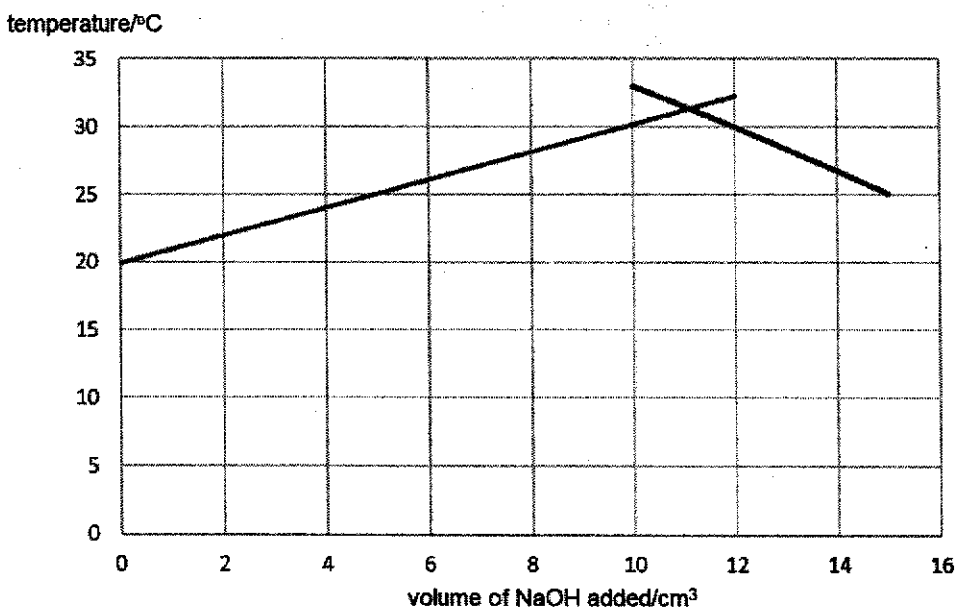
.....

.....

.....

..... [2]

A6 In an experiment, 20.0 cm^3 of dilute hydrochloric acid was placed in a styrofoam cup. 1.0 mol/dm^3 aqueous sodium hydroxide was added to the acid, 2.0 cm^3 at a time. The mixture was then stirred and the highest temperature reached was recorded after each addition. The graph below shows the results of the experiment.



(a) Name the type of energy change shown in the results.

..... [1]

(b) State the volume of aqueous sodium hydroxide required to neutralise 20.0 cm^3 dilute hydrochloric acid.

..... [1]

(c) Write a balanced chemical equation for the reaction. Include state symbols.

..... [2]

(d) Calculate the concentration, in mol/dm^3, of dilute hydrochloric acid used in the experiment.

[2]

A7 A student carried out a series of experiments to determine the speed of reaction between marble chips (calcium carbonate) and excess dilute nitric acid by measuring the volume of gas produced at a fixed time interval.

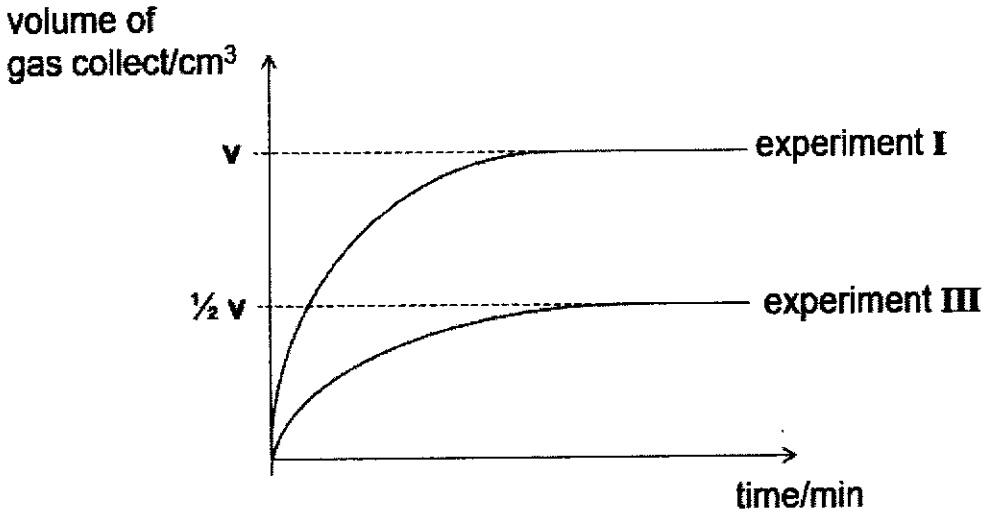
In experiment **I**, he used 5.0 g of marble chips and 200 cm^3 of 1.0 mol/dm^3 dilute nitric acid at 25 °C.

The experiments were repeated twice with some changes in the conditions used.

Experiment **II**: 5.0 g of calcium carbonate powder and 200 cm^3 of 1.0 mol/dm^3 dilute nitric acid at 25 °C.

Experiment **III**: **x** g of marble chips and 200 cm^3 of 1.0 mol/dm^3 of dilute nitric acid at 10 °C.

The graph below shows the volume of gas produced plotted against time.



(a) Write a balanced chemical equation, with state symbols, for the reaction between marble chips and dilute nitric acid.

..... [2]

(b) Describe a test to identify the gas produced in the reaction.

.....

..... [1]

(c) State the value of **x** in experiment **III**.

..... [1]

(d) Sketch on the axes, on page 7, the graph of experiment **II**. Label your graph. [1]

(e) State and explain one **other** method to increase the speed of reaction in experiment **I**.

.....

.....

..... [2]

A8 Red grapes contain a few coloured pigments. Small amounts of these pigments are separated by paper chromatography using a solvent.

(a) Suggest a solvent that can be used to separate the pigments.

..... [1]

(b) Explain why the solvent can allow the different pigments to be separated.

.....

..... [1]

(c) Tartaric acid, a weak acid with the formula of $C_2H_2(OH)_2(CO_2H)_2$, can also be extracted from grape juice.

(i) Describe a simple test to show that tartaric acid is weak acid.

.....

..... [2]

(ii) Calculate the relative molecular mass of tartaric acid.

[1]

(iii) Calculate the mass of tartaric acid if 0.0500 mol of tartaric acid is used in a reaction.

[1]

- End of Section A -

Section B: [20 marks]

Answer any **two** questions. Write your answers in the space provided.

B9 Group VII elements exists as diatomic molecules and are strong oxidising agents. Chlorine is an example of a group VII element that is highly reactive.

(a) Chlorine gas reacts readily with Group II metals to form a chloride salt.

(i) Name a Group II metal. Write a balanced chemical equation to show the reaction of chlorine with the metal.

.....

..... [2]

(ii) Draw a 'dot and cross' diagram to show the bonding in the chloride salt formed. Show only valence electrons.

[2]

(iii) Predict the electrical conductivity of the chloride salt at room temperature and pressure. Explain your answer.

.....

.....

..... [2]

(b) Aqueous chlorine is added to aqueous potassium bromide. The equation for the reaction is:

$$Cl_2\ (aq) + 2KBr\ (aq) \rightarrow 2KCl\ (aq) + Br_2\ (aq)$$

(i) Explain, in terms of oxidation states, why aqueous chlorine is a strong oxidising agent.

.....

.....

..... [2]

(ii) Describe and explain the observation made for the reaction.

.....

..... [2]

B10 Lead(II) sulfate is an insoluble salt that can be prepared in the laboratory.

(a) Describe the steps required to prepare a pure sample of lead(II) sulfate from lead(II) oxide.

.....

.....

.....

.....

.....

.....

.....

..... [6]

(b) Lead(II) sulfate has a melting point of 1087 °C.

(i) Sketch a labelled graph to show the cooling curve of molten lead(II) sulfate when it is cooled from 1300 °C to 800 °C.

[2]

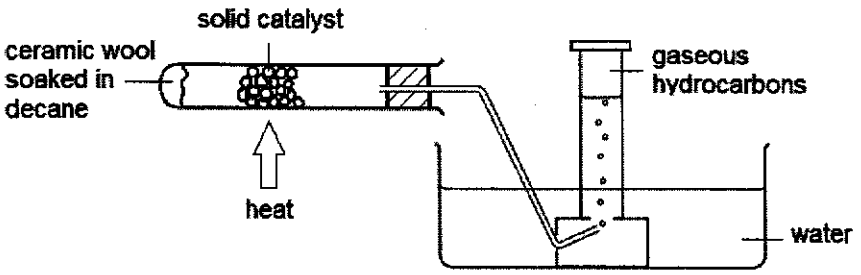
(ii) Describe the arrangement and movement of the particles of lead(II) sulfate at 800 °C.

.....

.....

..... [2]

B11 The apparatus shown below was set up and a sample of decane, $C_{10}H_{22}$, was heated strongly in the presence of a solid catalyst. The products obtained were a mixture of smaller hydrocarbons in gaseous state.



(a) Name the process above.

..... [1]

(b) Identify the solid catalyst and temperature used in the setup.

..... [2]

(c) A safety precaution for the experimental setup above is to ensure that the delivery tube is withdrawn from the water as soon as the heating stopped.

Explain why this is necessary.

.....

..... [1]

(d) Decane is broken down into 2 molecules of C_2H_4, hydrogen gas and another product, **X**.

(i) Deduce the chemical formula of **X**.

..... [1]

(ii) Which homologous series does **X** belong to?

..... [1]

(iii) Write a balanced chemical equation to show the complete combustion of **X**.

..... [1]

(iv) **X** is often found in the mixture of petrol.

Describe how petrol can be separated from petroleum.

.....

.....

.....

.....

..... [3]

- End of Paper -

DATA SHEET

Colours of Some Common Metal Hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

The Periodic Table of the Elements

key

proton (atomic) number
atomic symbol
name
relative atomic mass

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 **H** hydrogen 1										2 **He** helium 4
3 **Li** lithium 7	4 **Be** beryllium 9											5 **B** boron 11	6 **C** carbon 12	7 **N** nitrogen 14	8 **O** oxygen 16	9 **F** fluorine 19	10 **Ne** neon 20
11 **Na** sodium 23	12 **Mg** magnesium 24											13 **Al** aluminium 27	14 **Si** silicon 28	15 **P** phosphorus 31	16 **S** sulfur 32	17 **Cl** chlorine 35.5	18 **Ar** argon 40
19 **K** potassium 39	20 **Ca** calcium 40	21 **Sc** scandium 45	22 **Ti** titanium 48	23 **V** vanadium 51	24 **Cr** chromium 52	25 **Mn** manganese 55	26 **Fe** iron 56	27 **Co** cobalt 59	28 **Ni** nickel 59	29 **Cu** copper 64	30 **Zn** zinc 65	31 **Ga** gallium 70	32 **Ge** germanium 73	33 **As** arsenic 75	34 **Se** selenium 79	35 **Br** bromine 80	36 **Kr** krypton 84
37 **Rb** rubidium 85	38 **Sr** strontium 88	39 **Y** yitrium 89	40 **Zr** zirconium 91	41 **Nb** niobium 93	42 **Mo** molybdenum 96	43 **Tc** technetium -	44 **Ru** ruthenium 101	45 **Rh** rhodium 103	46 **Pd** palladium 106	47 **Ag** silver 108	48 **Cd** cadmium 112	49 **In** indium 115	50 **Sn** tin 119	51 **Sb** antimony 122	52 **Te** tellurium 128	53 **I** iodine 127	54 **Xe** xenon 131
55 **Cs** caesium 133	56 **Ba** barium 137	57 – 71 lanthanoids	72 **Hf** hafnium 178	73 **Ta** tantalum 181	74 **W** tungsten 184	75 **Re** rhenium 186	76 **Os** osmium 190	77 **Ir** iridium 192	78 **Pt** platinum 195	79 **Au** gold 197	80 **Hg** mercury 201	81 **Tl** thallium 204	82 **Pb** lead 207	83 **Bi** bismuth 209	84 **Po** polonium -	85 **At** astatine -	86 **Rn** radon -
87 **Fr** francium -	88 **Ra** radium -	89 - 103 actinoids	104 **Rf** Rutherfordium -	105 **Db** dubnium -	106 **Sg** seaborgium -	107 **Bh** bohrium -	108 **Hs** hassium -	109 **Mt** meitnerium -	110 **Ds** darmstadtium -	111 **Rg** roentgenium -	112 **Cn** copernicium -		114 **Fl** flerovium -		116 **Lv** livermorium -		

lanthanoids	57 **La** lanthanum 139	58 **Ce** cerium 140	59 **Pr** praseodymium 141	60 **Nd** neodymium 144	61 **Pm** promethium -	62 **Sm** samarium 150	63 **Eu** europium 152	64 **Gd** gadolinium 157	65 **Tb** terbium 159	66 **Dy** dysprosium 163	67 **Ho** holmium 165	68 **Er** erbium 167	69 **Tm** thulium 169	70 **Yb** ytterbium 173	71 **Lu** lutetium 175
actinoids	89 **Ac** actinium -	90 **Th** thorium 232	91 **Pa** protactinium 231	92 **U** uranium 238	93 **Np** neptunium -	94 **Pu** plutonium -	95 **Am** americium -	96 **Cm** curium -	97 **Bk** berkelium -	98 **Cf** californium -	99 **Es** einsteinium -	100 **Fm** fermium -	101 **Md** mendelevium -	102 **No** nobelium -	103 **Lr** lawrencium -

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

2020 4E5N Sci Chem Paper

Paper 1 Suggested Answers

21	22	23	24	25	26	27	28	29	30
B	D	D	A	A	C	B	A	A	C
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	A	B	C	B	A (Bio B)	A	D	D	A

2020 4E5N Sci Chem Paper

Paper 3 Suggested Answers

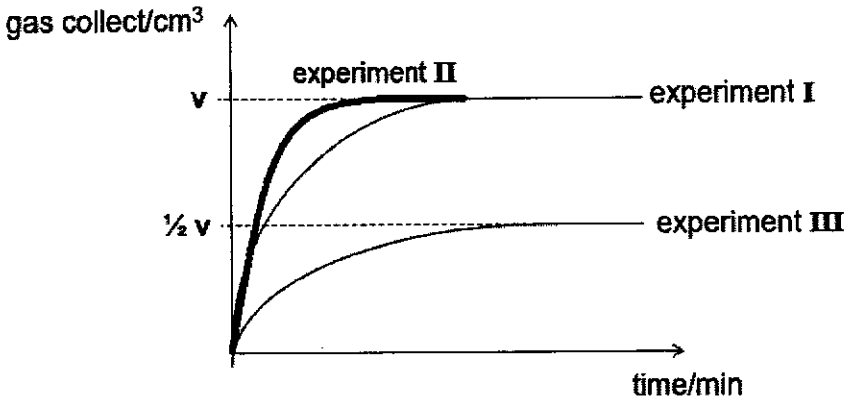
Section A

A1a	S and O	[1]
A1b	C*l*	[1]
A1c	F	[1]
A1d	K and I	[1]
A2a	**N**	[1]
A2b	**L**	[1]
A2c	**K** and **O**	[1]
A2d	**M**	[1]
A2e	**P**	[1]
A3a	mol of $Na_2S_2O_3$ = 10.0 / [2(23) + 2(32) + 3(16)] = 10.0 / 158 = 0.0633 mol [1] mol of HC*l* = (200 / 1000) x 0.20 = 0.0400 mol [1] $Na_2S_2O_3$: HC*l* 1 : 2 0.0633 mol : 0.127 mol Since 0.127 mol of HC*l* is required to react with 0.0633 mol of $Na_2S_2O_3$ but only 0.0400 mol of HC*l* is given, HC*l* is limiting. [1] [Deduct 1m overall if no 3 sig. fig. is given / poor presentation of working.]	[3]
A3b	HC*l* : SO_2 2 : 1 0.0400 mol : 0.0200 mol vol of SO_2 = 0.0200 x 24 = 0.480 dm^3 [Allow ecf.]	[1]
A3c	Sulfur dioxide produced will **cause irritation to eyes and lungs** if the space is not well-ventilated.	[1]
A4a	**M**: sulfuric acid **O**: barium sulfate **R**: hydrogen	[3]
A4b	Iron and zinc	[2]
A4c	Ba^{2+} (aq) + SO_4^{2-} (aq) → $BaSO_4$ (s)	[1]
A5a	**Y, Z, W** and **X**	[1]
A5b	metal | reaction with	[2]

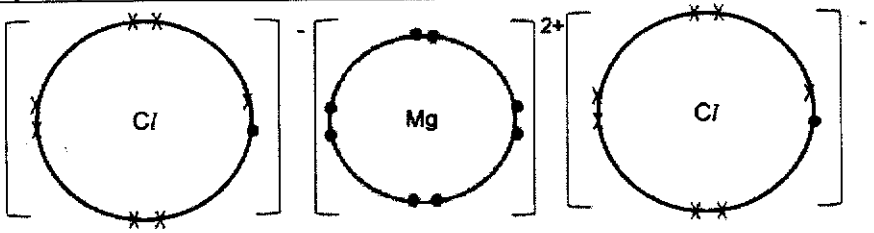
	cold water	steam	dilute hydrochloric acid	aqueous copper(II) sulfate
W	x	√	√	√
X	√	√	√	√
Y	x	x	x	x
Z	x	x	√	√

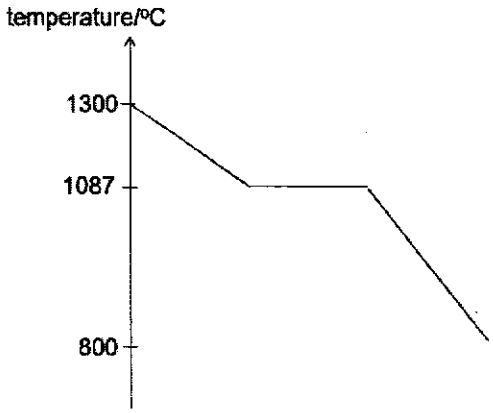
[Any 2 correct answers 1m; All 4 correct answers 2m]

A5ci	Iron	[1]
A5cii	Steel is **stronger / harder** than metal **W**. The **atoms** of different elements have **different sizes** that **disrupt the orderly arrangement** of layers of metal atoms in pure metals. [1] This **prevents the layers of atoms from sliding over one another** when a **force is applied**. [1]	[2]
A6a	Exothermic	[1]
A6b	11 cm^3 or 11.2 cm^3	[1]
A6c	HCl (aq) + NaOH (aq) → $NaCl$ (aq) + H_2O (l) [1m for correct formula; 1m for correct state symbols]	[2]
A6d	mol of NaOH = 1.0 x (11 / 1000) = 0.0110 mol [1] or 0.0112 mol NaOH : HCl 1 : 1 0.0110 mol : 0.0110 mol or 0.0112 mol : 0.0112 mol conc of HCl = 0.0110 / (20.0 / 1000) = 0.550 mol/dm^3 [1] or 0.560 mol/dm^3 [Second mark will not be awarded if mole ratio is not shown.]	[2]
A7a	$2HNO_3$ (aq) + $CaCO_3$ (s) → $Ca(NO_3)_2$ (aq) + CO_2 (g) + H_2O (l) [1m for correct formula; 1m for correct balancing and state symbols]	[2]
A7b	**Bubble** gas into **limewater**. **White precipitate** is formed in limewater if **carbon dioxide** is produced.	[1]
A7c	2.5	[1]

A7d		[1]
A7e	**Increase** the **concentration** of nitric **acid.** [1] With higher concentration of acid, there are **more reacting particles in the same volume / per unit volume.** This **increases the frequency of successful collision** between reacting particles and hence increases speed of the reaction. [1]	[2]
A8a	Water / Ethanol	[1]
A8b	Different pigments have **different solubility** in the solvent.	[1]
A8ci	Add a few drops of **Universal Indicator** into tartaric acid. [1] Universal Indicator will turn from **green to yellow/orange** if it is a weak acid. [1]	[2]
A8cii	Mr of tartaric aicd = [4(12) + 6(1) + 6(16)] = 150	[1]
A8ciii	mass of tartaric acid = 150 x 0.0500 = 7.50 g	[1]

Section B

B9ai	magnesium $Mg + Cl_2 \rightarrow MgCl_2$ [Accept any other Group II metals.]	[2]
B9aii	 [1m for correct number of charges; 1m for correct number of valence electrons] [Deduct 1m if students do not show alternate arrangement of ions]	[2]
B9aiii	It **does not conduct electricity at solid state.** [1] It **does not have free moving ions** to carry charges as they are held in **fixed position in the giant lattice structure.** [1]	[2]
B9bi	Aqueous chlorine / Cl_2 **oxidises KBr to form Br_2.** [1] **KBr is oxidised to form Br_2** as the **oxidation state of Br increases from -1 in KBr to 0 in Br_2.** [1]	[2]

B9bii	**Colourless solution** turns **red-brown**. [1] **Chlorine**, being **more reactive, displaces from bromine from potassium bromide / its solution.** [1]	[2]
B10a	Add **excess** lead(II) oxide into **nitric acid**. [1] **Filter** to **remove excess** lead(II) oxide. [1] Add **aqueous sodium sulfate / sulfuric acid** into the **filtrate, aqueous lead(II) nitrate.** [1] Stir for lead(II) sulfate precipitate to form. **Filter** to obtain lead(II) sulfate as **residue**. [1] **Wash** residue with **distilled water**. [1] **Dry** residue between pieces of **filter paper**. [1] [If method is wrong but some steps are correct, total mark cannot be more than 3m.]	[6]
B10bi	 [1m for correct labelling of the axis and temperature] [1m for correct shape and graph does not exceed 1300 °C or 800 °C] [No mark award if shape is wrong.]	[2]
B10bii	The particles are **closely packed** in an **orderly manner**. [1] They are **vibrating and rotating at fixed position**. [1]	[2]
B11a	Cracking	[1]
B11b	Aluminium oxide / Silicon dioxide catalyst [1] 600 °C [1] [Accept temperature between 450 °C to 700 °C.]	[2]
B11c	To prevent **breakage** of test tube due to the **suck back** of water.	[1]
B11dI	C_6H_{12}	[1]
B11dII	Alkenes	[1]
B11diii	$C_6H_{12} + 9O_2 \rightarrow 6H_2O + 6CO_2$	[1]
B11div	Petroleum is first **heated** in a **furnace**. It then **vaporises** and is passed into a **fractionating column**. [1] The vapour then **cools and condenses at different heights** depending on their **boiling points**. [1] The **fraction** with the **lowest boiling point condenses** at the **top** of the column. The **fraction** with the **highest boiling point condenses** at the **bottom** of the column. **Petrol** is collected near the **top of the column**.[1]	[3]